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LISTS OF SPECIES

Scorpions, state of Bahia, northeastern Brazil

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ABSTRACT: We report herein an updated and commented list of scorpions occurring in state of Bahia, northeastern Brazil. Data comprising a period of 100 years (1908-2008) were obtained from seven major Brazilian collections. Twenty eight species were identified and grouped in seven genera (*Bothriurus* Peters, 1861, *Ananteris* Thorell, 1891, *Isometrus* Ehrenberg, 1828, *Physoctonus* Mello-Leitão, 1934, *Rhopalurus* Thorell, 1876, *Tityus* C.L.Koch, 1836 and *Troglorhopalurus* Lourenço, Baptista and Giupponi, 2004) and two families (Bothriuridae Simon, 1880 and Buthidae C.L. Koch, 1837). This new list increases in 50 % the known scorpiofauna of Bahia, which now represents approximately 22 % of the Brazilian species, recorded in all biomes and phytophysiognomies from the coastal zone to high altitude areas (3-1,268 m). Seven species are endemic to Bahia and three of them could be included in the Brazilian National Red List, which would promote action plans towards their conservation.

INTRODUCTION

The order Scorpiones represents only 1.5 % of the known arachnids, comprising 16 families, 155 genera and approximately 1,500 species (Fet *et al.* 2000), with a total richness estimated in 7,000 species (Coddington and Colwell 2001). Nearly 50 % of the described species occurs on the Neotropical region (8 families, 48 genera and about 800 species) (Lourenço 2002a), and about 130 species are recognized in Brazil. Considering the vast territorial dimension of the country and its vegetation diversity, the Brazilian scorpion fauna cannot be considered megadiverse (Lourenço and Eickstedt 2003). However, in recent years, high rates of richness, diversity and endemism for the scorpiofauna have been recorded for some areas (*e.g.* Höfer *et al.* 1996; Lourenço 2005), and for others, the studies are scanty, despite the frequent findings of undescribed species, as in the state of Bahia.

The first scorpion species described for Bahia was *Tityus bahiensis* (Perty, 1833), however, Lourenço (1982a) stated that this location might have been misunderstood, and that this species might not even occur in the region. In the first list of scorpions from Brazil (Maurano 1918), only three species were listed for Bahia: *Centrurus stenochirus* (Penther, 1913) (city of Barra), *Centrurus barythenar* (Penther, 1913) (city of Juazeiro), both synonimized by Lourenço (1982b) with *Rhopalurus rochai* Borelli, 1910, and *Bothriurus vittatus* (Guerin-Meneville, 1838) (city of Juazeiro), misidentified by Karl Kraepelin (1848-1915), once this species is restricted to Chile (Mattoni 2002). In 1935, Pessôa indicated the occurrence of two more species for this region: *Tityus serrulatus* Lutz and Mello, 1922 and *T. stigmurus* (Thorell, 1876). Until the 1950's, only seven species and one subspecies were registered for Bahia (Mello-Leitão 1945): *Isometrus maculatus* (DeGeer, 1778), *Rhopalurus agamemnom* (C.L. Koch, 1839), *R. rochai*, *R. stenochirus* [synonimized by Lourenço (1982b) with *Rhopalurus rochai*], *Rhopalurus stenochirus goiasensis* [synonimized by Lourenço (1982b) with *Rhopalurus acromelas* Lutz and Mello, 1922], *Tityus bahiensis*, *T. serrulatus* and *T. stigmurus.* However, since the 1980's this number is increasing, due to the expansion of field work and, consequently, publications, reaching a total of 18 species in last decade (Lira-da-Silva *et al.* 2005). As a result of intensive field work in the last 12 years, three species were registered for the first time to Bahia (Lourenço 2002b, Lira-da-Silva *et al.* 2005), and another nine species belonging to four different genera were described (Lourenço 1997; Lourenço and Pinto-da-Rocha 1997; Lourenço 2001a; 2003; 2004; Lourenço *et al.* 2004; Candido *et al.* 2005; Lenarducci *et al.* 2005; Giupponi *et al.* 2009). Besides, one species was synonimized (Souza *et al.* 2009) and another was relocated to a different genus (Lourenço 2007). Thus, it is necessary to update the species inventory of scorpions from the State of Bahia, to summarize the recent modifications and findings.

Presently, scorpions from Bahia are present in scientific collections of some Brazilian states, especially in public institutions. Scientific collections are the most important source of information regarding the composition of the biodiversity and its spatial and temporal distribution. Therefore, they constitute permanent records of the natural heritage of the Earth and the basis to develop several researches (Magalhães *et al.* 2005). Since the beginning of the 20th century, the identification and recording of scorpions by researchers established a database with the confidence necessary to support this work on the state of knowledge of the scorpiofauna from Bahia.

MATERIAL AND METHODS

Study site

The state of Bahia is located in the northeast region of Brazil between parallels 8° and 18° S and meridians 37° and 45° W, with an area of 565 thousand km^2, which represents 7 % of the Brazilian territory and 36 % of the northeast region. It has the longest coastline of the country and comprises 417 cities from the sea level until

more than 1,200 m high. The weather varies from dry to humid, the temperature ranges from 14 to 34 °C and the annual precipitation from 300 to more than 2,000 mm (SEI 2008). The Atlantic Forest biome occurs especially in the East portion; to the West, the semiarid occupies more than 50 % of the state, and a great variety of "Caatingas", savannas, different types of forests and "campos rupestres" occur (Giulietti 2005). These geographic and climatic peculiarities are determinant to the occurrence of one of the most diverse biota in the whole country.

Data Collection

Seven collections from four Brazilian states were consulted: Instituto Butantan, São Paulo (IBSP – A.D. Brescovit, curator); Museu de Zoologia da Universidade Federal da Bahia (MZUFBA – T.K. Brazil, curator); Museu de Zoologia da Universidade de São Paulo (MZSP – R. Pinto-da-Rocha, curator); Centro de Informações Antiveneno do Estado da Bahia (CIAVE – D.S. Rodrigues, director); Museu Nacional, Rio de Janeiro (MNRJ – A.B. Kury, curator); Laboratório de Invertebrados Terrestres da Universidade Federal de Pernambuco (UFPE – C.M.R. Albuquerque, curator); and Universidade Estadual do Sudoeste da Bahia (UESB – L. Boccardo, curator). In total, there were 5,700 records, comprehending a period of 100 years (1908-2008).

In order to complement the species lists and records, we also included data from taxonomic articles of the species whose type locality were in Bahia (Lourenço 1981; Lourenço and Eickstedt 1984; Lourenço 1997; Lourenço and Pinto-da-Rocha 1997; Lourenço 2001a; 2003; 2004; Lourenço *et al.* 2004; Candido *et al.* 2005; Lenarducci *et al.* 2005; Giupponi *et al.* 2009), and articles with the geographical distribution of scorpions which occur in this region (Maurano 1918; Pessôa 1935; Mello-Leitão 1945; Lourenço 1982a; b; c; Lourenço and Eickstedt 1988; Lourenço and Clodsley-Thompson 1996; Lira-da-Silva *et al.* 1997; Lourenço and Clodsley-Thompson 1999; Fet *et al.* 2000; Ministério da Saúde 2001; Lourenço 2001b; 2002b; Kovařík 2003; Lira-da-Silva *et al.* 2005; Santos *et al.* 2006; Lourenço 2007; Bertani *et al.* 2008; Souza *et al.* 2009).

Results and Discussion

Twenty eight species grouped in seven genera (*Bothriurus* Peters, 1861, *Ananteris* Thorell, 1891, *Isometrus* Ehrenberg, 1828, *Physoctonus* Mello-Leitão, 1934, *Rhopalurus* Thorell, 1876, *Tityus* C.L.Koch, 1836 and *Troglorhopalurus* Lourenço, Baptista and Giupponi, 2004) and two families (Bothriuridae Simon, 1880 and Buthidae C.L. Koch, 1837) were identified (Table 1; Figures 1-3). Three new occurrences were recorded [*Bothriurus araguayae* Vellard, 1934, *Ananteris franckei* Lourenço, 1982 and *Tityus costatus* (Karsch, 1879)] and eight species had their distributions expanded over the state [*Ananteris evellynae* Lourenço, 2004, *A. mauryi* Lourenço, 1982, *Physoctonus debilis* (C.L. Koch, 1840), *Tityus aba* Candido, Lucas, Souza, Diaz and Lira-da-Silva, 2005, *T. brazilae* Lourenço and Eickstedt, 1984, *T. kuryi* Lourenço, 1997, *T. serrulatus* and *T. stigmurus*]. This new list increases in 50 % the scorpiofauna of Bahia, which represents approximately 22 % of the Brazilian scorpion species (Figures 1-3).

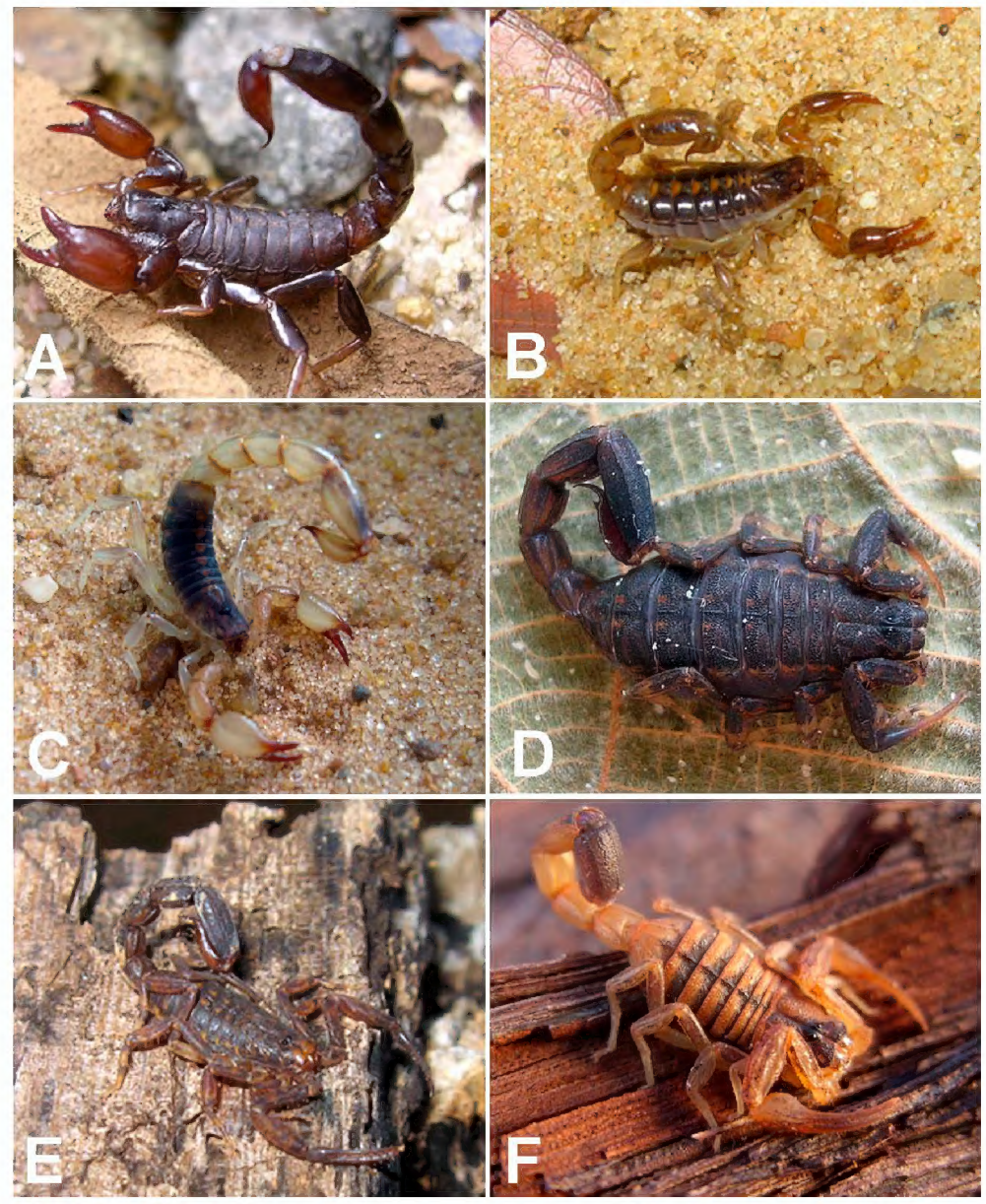

Figure 1. Scorpions from the state of Bahia, northeastern Brazil: A) *Bothriurus araguayae*; B) *Bothriurus asper*; C) *Bothriurus rochai*; D) *Ananteris balzanii*; E) *Ananteris mauryi*; F) *Physoctonus debilis*. Photos by D.M. Candido (A and D) and T.J. Porto (B, C, E and F).

The scorpions were recorded in all biomes and phytophysiognomies, from the coastal zone to high altitude areas throughout the state (3-1,268 m). The "Caatinga" biome showed the greatest richness of species, with 22 of the 28 species recorded (79 % of the total richness), followed by the Atlantic Forest, with 16 (57 %), and the "Cerrado", with 11 (39 %). The distribution of the species was unequal, existing generalist and widely distributed scorpions occurring in all three biomes, such as *Tityus serrulatus* and *T. stigmurus*, and also scorpions restricted to a single locality, such as *Ananteris kuryi* Giupponi, Vasconcelos and Lourenço, 2009, *Rhopalurus guanambiensis* Lenarducci, Pinto-da-Rocha and Lucas, 2005, *R. lacrau* Lourenço and Pinto-da-Rocha, 1997 and *Troglorhopalurus translucidus* Lourenço, Baptista and Giupponi, 2004 (Table 1). On the other hand, there were also wide distributed species occurring in only one vegetation type, such as *Rhopalurus rochai* in open vegetation areas, like "Caatinga" and "Cerrado", and *Tityus brazilae* in coastal forested areas (Atlantic Forest).

The occurrence pattern of *Isometrus maculatus* in the Atlantic Forest region from the state of Bahia corroborates its theoretical preference for forested environments (Lourenço 1982c). Likewise, the idea of restriction of *Physoctonus debilis* and the *Rhopalurus* species to open vegetation environments (Lourenço 1982b; Lira-da-Silva *et al.* 2005), such as "Caatinga" and "Cerrado", is also reinforced. Besides, the absence of *Tityus bahiensis* in the state of Bahia, proposed by Lourenço (1982a), is reinforced.

Seven species (25 %) may be considered endemic to the state of Bahia: *Ananteris evellynae, A. kuryi, R. lacrau, Tityus aba, T. cylindricus* (Karsch, 1879), *T. kuryi*

and *Troglorhopalurus translucidus*. The endemism of *A. evellynae*, *A. kuryi* and *T. cylindricus* may be related to the lack of knowledge about their distribution. However, the endemism of *Rhopalurus lacrau, Tityus aba*, *T. kuryi* and *Troglorhopalurus translucidus* should be considered reliable and reflect their occurrence in particular microhabitats. The Chapada Diamantina region is responsible for 57 % of these endemisms: *R. lacrau* (city of Itaetê), *Tityus aba* (cities of Morro do Chapéu and Rio de Contas), *Tityus kuryi* (cities of Andaraí, Iraquara and Palmeiras) and *Troglorhopalurus translucidus* (city of Lençóis).

Only 163 from the 417 municipalities of Bahia (39 %) presented at least one registered species (Figure 4). The absence of records is considered rather a lack of sampling than absence of occurrence. Furthermore, those nine recent described species, three new occurrences and eight species which had their distributions extended in the state of Bahia, indicate that the scorpiofauna of this region remains partially unknown. The increase of researches in this region and the examination of specimens preserved on different scientific collections might reveal other new occurrences and even new species.

The large number of scorpions examined (approximately 6,000) and the long period analyzed (100 years), allowed us to make considerations concerning the conservation status of some species. The Brazilian National Red List includes 627 species of fauna, with 130 (21 %) terrestrial invertebrates (Machado *et al.* 2008). Although arachnids appeared in the Brazilian National Red List for the first time in 2008, they were not represented by any scorpion species. The list included mostly animals found in restricted

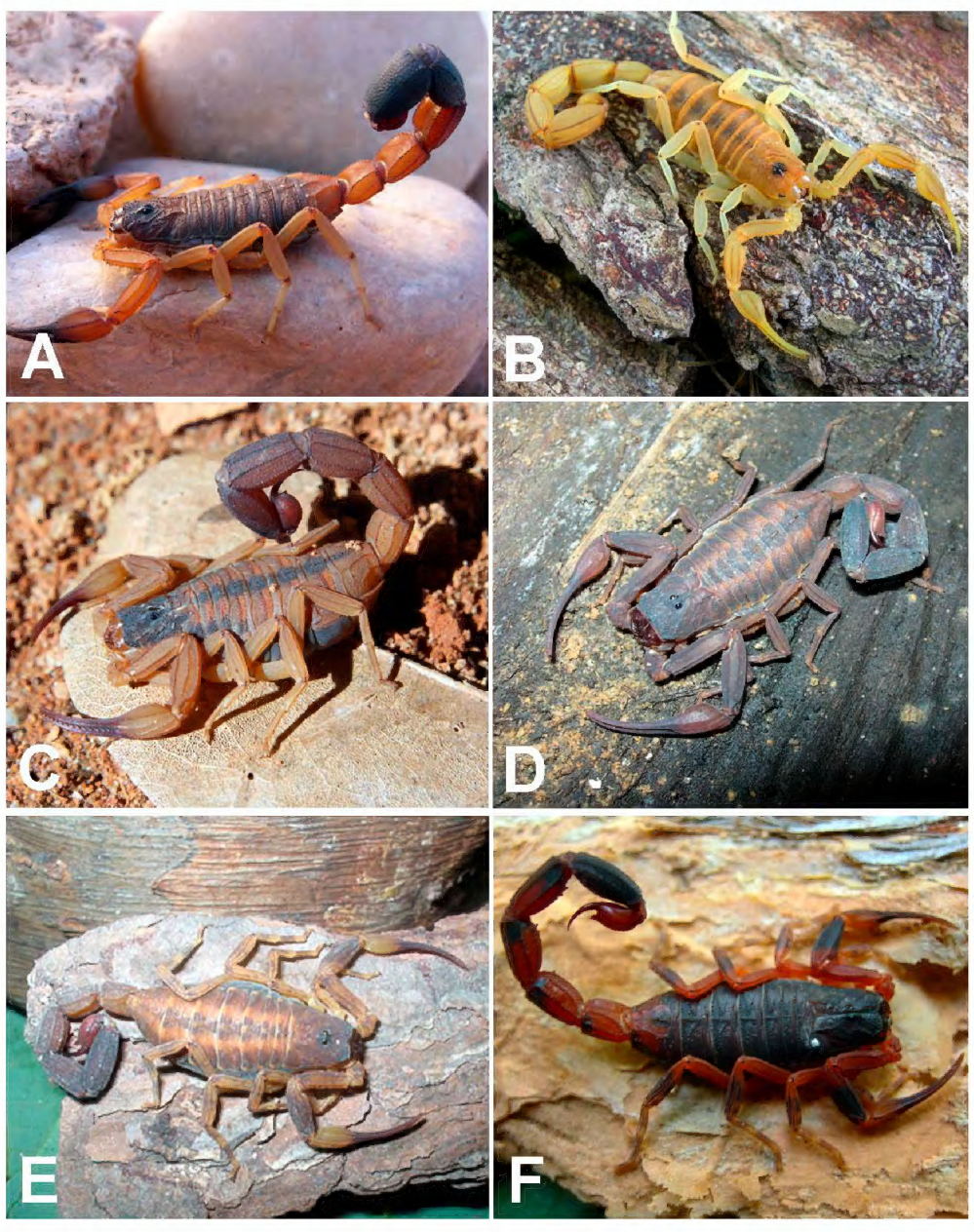

FIGURE 2. Scorpions from the state of Bahia, northeastern Brazil: A) *Rhopalurus agamemnom*; B) *Rhopalurus rochai*; C) *Tityus aba*; D) *Tityus brazilae*; E) *Tityus costatus*; F) *Tityus kuryi*. Photos by T.J. Porto.

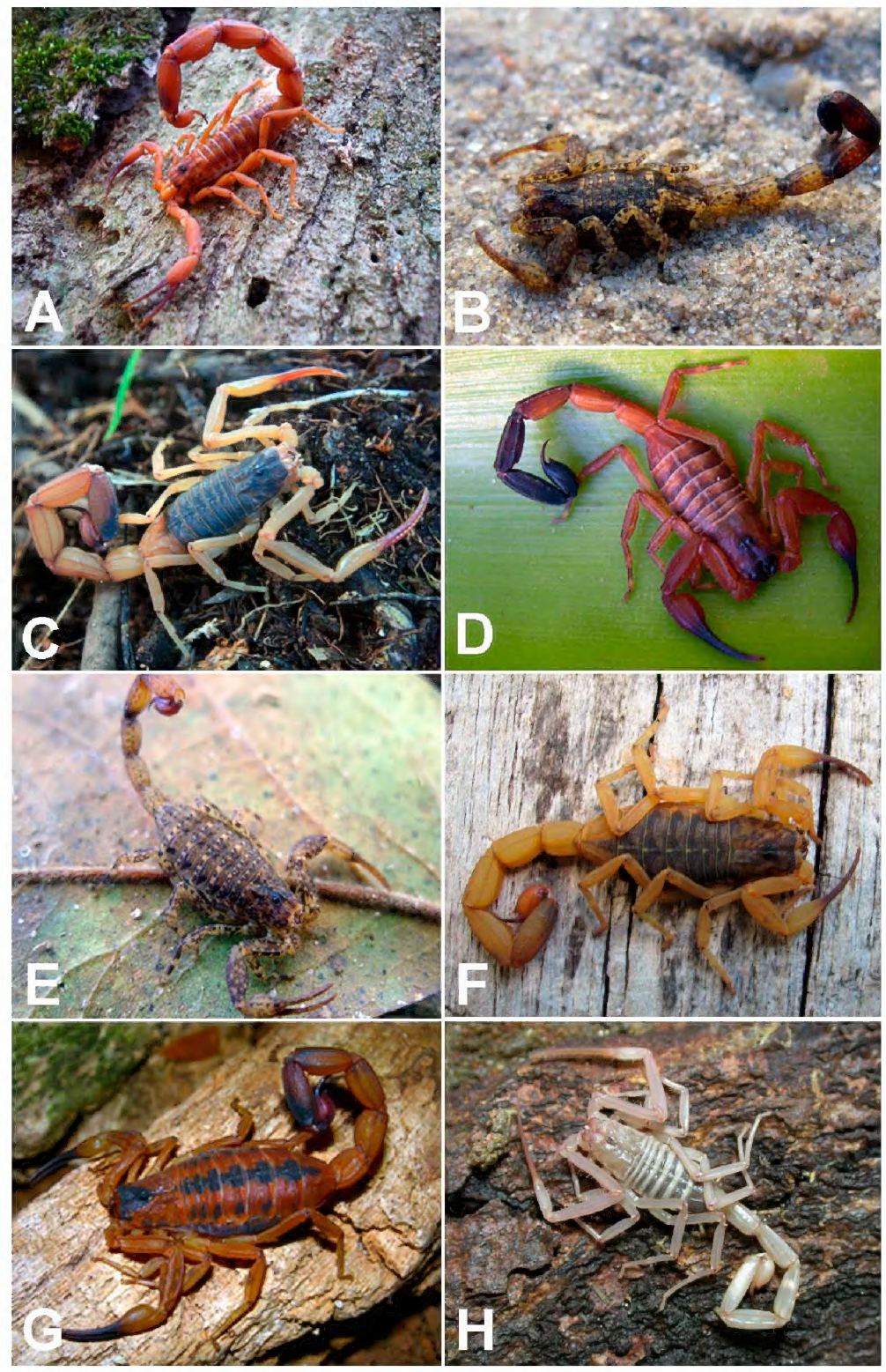

FIGURE 3. Scorpions from the state of Bahia, northeastern Brazil: A) *Tityus martinpaechi*; B) *Tityus mattogrossensis*; C) *Tityus melici*; D) *Tityus neglectus*; E) *Tityus pusillus*; F) *Tityus serrulatus*; G) *Tityus stigmurus*; H) *Troglorhopalurus translucidus*. Photos by T.J. Porto (A, B, C, D, E, F and G) and P.M. Costa (H).

environments or those whose populations live in areas largely impacted by urbanization (Machado *et al.* 2008). Regarding the 28 scorpions registered for Bahia state, three species should be considered threatened. *Tityus kuryi* should be included under the "vulnerable" category, because it has a narrow distribution, restricted to few localities of high altitude areas in the Chapada Diamantina, and the current agriculture development in this region may severely compromise the future of this specie. *Rhopalurus lacrau* and *Troglorhopalurus translucidus* should also be included under the "vulnerable" category, because they are troglobitic scorpions restricted to caves in the Chapada Diamantina region that receive tourist visitation without access control (Table 1), and habitats alteration may lead to extinction.

The most effective preservation policy to ensure the maintenance of these populations is the protection of their habitats and management of the touristic activity at an ecologically acceptable approach. Missing data on the species distribution and their threatened status make it difficult to promote mitigating actions toward their conservation, and eventual decisions about biodiversity conservation.

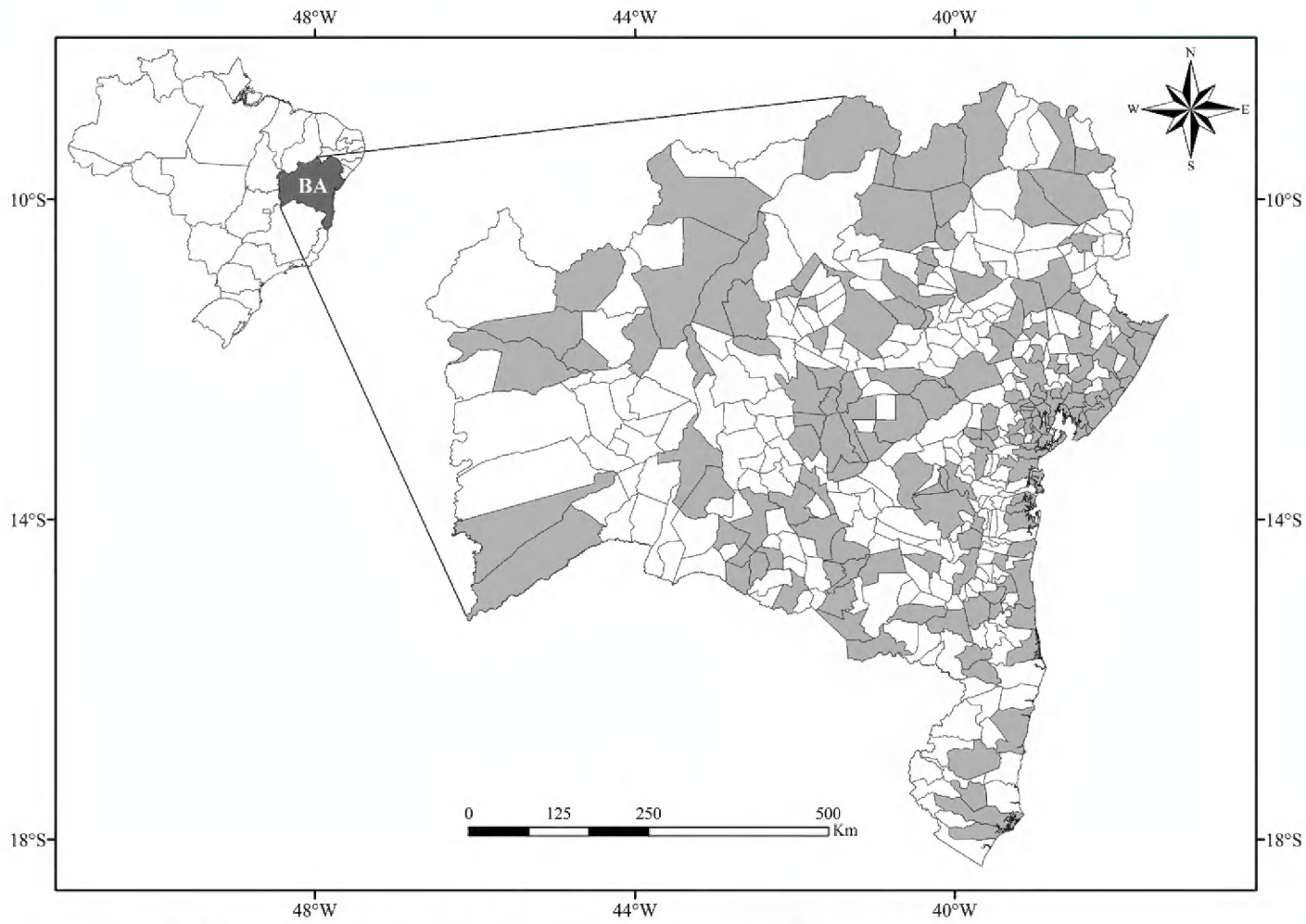

Figure 4. Municipalities of the state of Bahia with at least one registered species of scorpion.

Table 1. List of scorpion species with occurrence recorded in the state of Bahia, northeastern Brazil, by biome and cities. CA = Caatinga; CE = Cerrado; AF = Atlantic Forest; - Not registered; * Restricted to the cave Lapa do Bode (Itaetê, Bahia, Brazil); ** Specie adapted to urban environment.; *** Restricted to the cave Gruta do Lapão (Lençóis, Bahia, Brazil).

TAXONOMIC GROUP	BIOME			RECORDED CITIES
	CA	CE	AF	
BOTHRIURIDAE				
Bothriurus araguayae Vellard, 1934	X	-	X	Alagoinhas, Anagé, Itapé and Gentil do Ouro.
Bothriurus asper Pocock, 1893	X	X	X	Alagoinhas, Anagé, Barreiras, Bom Jesus da Lapa, Cabaceiras do Paraguaçu, Cachoeira, Caculé, Camaçari, Campo Formoso, Canudos, Central, Cruz das Almas, Entre Rios, Esplanada, Esplanada, Feira de Santana, Jaborandi, Jandaíra, Jequié, Jeremoabo, Jussari, Lafaiete Coutinho, Lauro de Freitas, Lençóis, Maracás, Mata de São João, Mucugê, Nova Soure, Palmeiras, Paulo Afonso, Riachão do Jacuípe, Riacho de Santana, Rio de Contas, Rio Real, Salvador, Santa Terezinha, Santo Amaro, Santo Estevão, Seabra, Senhor do Bonfim, Simões Filho and Várzea do Poço.
Bothriurus rochai Mello-Leitão, 1932	X	X	X	Angical, Barra, Barreiras, Cachoeira, Camaçari, Central, Cipó, Cocos, Entre Rios, Esplanada, Itaparica, Jaborandi, Jeremoabo, Jussari, Lauro de Freitas, Maracás, Mata de São João, Mucugê, Pindobaçu, Queimadas, Salvador, Santa Rita de Cássia, Tucano and Xique-Xique.
BUTHIDAE				
Ananteris balzanii Thorell, 1891	X	X	X	Barreiras, Entre Rios, Esplanada, Jandaíra, Jeremoabo, Mucugê, Paulo Afonso, Porto Seguro and Salvador.
Ananteris evellynae Lourenço, 2004	X	X	-	Cocos and Guanambi.
Ananteris franckei Lourenço, 1982	X	-	X	Cachoeira, Lafaiete Coutinho, Senhor do Bonfim and Una.
Ananteris kuryi Giupponi, Vasconcelos and Lourenço, 2009	-	-	X	Porto Seguro.
Ananteris mauryi Lourenço, 1982	-	-	X	Cachoeira, Camaçari, Conde, Entre Rios, Ilhéus, Lafaiete Coutinho, Maracás and Salvador.
Isometrus maculatus (DeGeer, 1778)	-	-	X	Camaçari, Caravelas, Cruz das Almas, Esplanada, Mata de São João and Salvador.
Physoctonus debilis (C.L. Koch, 1840)	X	-	-	Anagé, Barra, Central, Curaçá, Juazeiro and Paulo Afonso.
Rhopalurus acromelas Lutz and Mello, 1922	X	X	-	Barreiras, Pilão Arcado, Riachão das Neves, Rio de Contas and Wanderley.
Rhopalurus agamemnon (C.L. Koch, 1839)	X	X	-	Barreiras, Cocos, Jaborandi, Pilão Arcado, Riachão das Neves, Santa Rita de Cássia and Sobradinho.
Rhopalurus guanambiensis Lenarducci, Pinto-da-Rocha and Lucas, 2005	X	-	-	Guanambi.
Rhopalurus lacrau Lourenço and Pinto-da-Rocha, 1997 *	X	-	-	Itaetê.

Table 1. Continued.

TAXONOMIC GROUP	BIOME			RECORDED CITIES
	CA	CE	AF	
Rhopalurus rochai Borelli, 1910	X	X	-	Anagé, Aracatu, Araci, Barra, Brumado, Campo Formoso, Caetité, Caraíbas, Casa Nova, Central, Conceição do Coité, Curaça, Feira de Santana, Gentil do Ouro, Guanambi, Ibotirama, Ipupiara, Ituaçu, Jacobina, Jaguarari, Jequié, Jeremoabo, Juazeiro, Jussara, Lafaiete Coutinho, Livramento de Nossa Senhora, Maetinga, Maracás, Milagres, Paulo Afonso, Pindai, Poções, Queimadas, Riacho de Santana, Rodelas, Sobradinho, Tucano, Vitória da Conquista and Xique-Xique.
Tityus aba Candido, Lucas, Souza, Diaz and Lira-da-Silva, 2005	X	-	-	Anagé, Caetité, Iraquara, Lafaiete Coutinho, Morro do Chapéu, Poções, Riacho de Santana and Rio de Contas.
Tityus brazilae Lourenço and Eickstedt, 1984 **	-	-	X	Alagoinhas, Amargosa, Aratuípe, Cachoeira, Cairu, Camaçari, Camacan, Camamu, Canavieiras, Candeias, Caravelas, Elísio Medrado, Ibicuí, Igrapiúna, Ilhéus, Itabuna, Itacaré, Itamaraju, Itanagra, Itapetinga, Jaguaripe, Lauro de Freitas, Mata de São João, Nova Viçosa, Porto Seguro, Ruy Barbosa, Salvador, São Francisco do Conde, Saubara, Simões Filho, Teixeira de Freitas, Terra Nova, Una, Valença and Vera Cruz.
Tityus costatus (Karsch, 1879)	-	-	X	Cruz das Almas, Itororó, Porto Seguro and Teixeira de Freitas.
Tityus cylindricus (Karsch, 1879)				Uncertain location.
Tityus kuryi Lourenço, 1997	X	-	-	Andaraí, Iraquara and Palmeiras.
Tityus martinpaechi Lourenço, 2001	X	-	X	Canarana, Central and Salvador.
Tityus mattogrossensis Borelli, 1901	X	X	X	Alagoinhas, Caetité, Camaçari, Cocos, Dias D'Ávila, Jaborandi, Jeremoabo, Mata de São João, Pedrão, Salvador and Simões Filho.
Tityus melici Lourenço, 2003	X	-	-	Caetité and "Serra da Jurema".
Tityus neglectus Mello-Leitão, 1932	X	-	X	Camaçari, Camamu, Dias D'Ávila, Elísio Medrado, Entre Rios, Itaberaba, Itacaré, Jeremoabo, Maracás, Mata de São João, Miguel Calmon, Nova Viçosa, Salvador, Una, Valença and Vera Cruz.
Tityus pusillus Pocock, 1893	X	X	X	Alagoinhas, Barreiras, Camaçari, Entre Rios, Itanagra, Jeremoabo, Mata de São João and Salvador.
Tityus serrulatus Lutz and Mello, 1922 **	X	X	X	Alagoinhas, Amargosa, Amélia Rodrigues, Anagé, Andaraí, Aracatu, Barreiras, Boa Vista do Tupim, Bom Jesus da Lapa, Boninal, Caculé, Caetité, Camaçari, Candeias, Cândido Sales, Catu, Cocos, Conceição de Feira, Conceição do Almeida, Condeúba, Cruz das Almas, Dias D'Ávila, Elísio Medrado, Encruzilhada, Governador Mangabeira, Guanambi, Ibicoara, Igatu, Ilhéus, Inhambupe, Ipiaú, Ipirá, Iraquara, Irecê, Itaberaba, Itabuna, Itaeté, Itagiba, Itaju do Colônia, Itambé, Itaparica, Itapebi, Itapetinga, Itiruçu, Ituaçu, Ituberá, Jacobina, Jaguaquara, Jequié, Lauro de Freitas, Lençóis, Licínio de Almeida, Maracás, Maragojipe, Mata de São João, Milagres, Mucugê, Muritiba, Nazaré, Nova Redenção, Nova Soure, Palmeiras, Paulo Afonso, Piatã, Poções, Porto Seguro, Potiraguá, Queimadas, Rio de Contas, Ruy Barbosa, Salvador, Santa Rita de Cássia, Santa Teresinha, Santo Amaro, Santo Antonio de Jesus, São Felipe, São Felix, São Francisco do Conde, São Gonçalo dos Campos, São Sebastião do Passe, Seabra, Simões Filho, Teixeira de Freitas, Terra Nova, Tremedal, Tucano, Ubaíra, Urandi, Vera Cruz and Vitória da Conquista
Tityus stigmurus (Thorell, 1876) **	X	X	X	Alagoinhas, Barreiras, Cachoeira, Caculé, Camaçari, Campo Formoso, Candeias, Cícero Dantas, Cruz das Almas, Entre Rios, Esplanada, Feira de Santana, Gentil do Ouro, Inhambupe, Irará, Itaberaba, Itaju do Colônia, Itaparica, Jacobina, Jequié, Jeremoabo, Lauro de Freitas, Lençóis, Mata de São João, Miguel Calmon, Milagres, Mucugê, Nova Soure, Olindina, Paulo Afonso, Piatã, Rio de Contas, Ruy Barbosa, Salvador, Santa Bárbara, Santo Amaro, Santo Estevão, São Felipe, Saúde, Senhor do Bonfim, Serrinha, Simões Filho, Tucano, Ubaíra and Vitória da Conquista.
Troglorhopalurus translucidus Lourenço, Baptista and Giupponi, 2004 ***	X	-	-	Lençois.

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